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Childhood negative dental experiences and tooth loss in later life: A 25-year longitudinal study in Sweden

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ABSTRACT

Background: Negative dental experiences (NDEs) are visits to the dentist reported as unpleasant, aversive or traumatic. There is cross-sectional evidence linking NDEs with poorer oral health. However, the long-term impact of childhood NDEs on adult oral health remains unknown.

Objective: This study explored the association between childhood NDEs and changes in tooth loss over 25 years among Swedish older adults, and the role of dental visits in explaining such an association. We used data from 6154 adults, members of a cohort study that started in 1992 when participants were 50 years old. All data were self-reported through postal questionnaires (6 in total, one every 5 years). Information on childhood NDEs was collected at baseline only. Tooth loss was the repeated outcome measure. Mixed effects logistic regression models were used to test the association between childhood NDEs and tooth loss adjusting for confounders.

Results: Childhood NDEs was positively associated with greater odds of experiencing tooth loss and its rate of change over the 25-year period. Although having a dental visit within the past year was positively associated with childhood NDEs and inversely associated with incidence of tooth loss, it explained very little of the association between childhood NDEs and tooth loss in later life.

Conclusion: The findings underscore the long-lasting damaging effects of early life NDEs on adult oral health.

Clinical Significance: A positive patient-dentist relationship starts early in life. Early visits to the dentist are essential to build an enduring relationship of trust between people and healthcare providers.

INTRODUCTION

Tooth loss is the ultimate oral health measure, resulting from life-long exposure to dental diseases and their associated treatment over the lifespan [1]. The impact of early life factors on tooth loss in later life has gained increasing attention owing to their relevance for a healthy ageing [2] and the greater availability of longitudinal data. Most longitudinal evidence focusses on early socioeconomic circumstances, with most [3-6], but not all studies [7, 8], reporting greater risk of tooth loss among people raised in disadvantaged families. A greater risk of tooth loss in older life has also been reported among people with poorer childhood cognitive ability [9], those experiencing childhood abuse or neglect [10] and negative life events [11].

Negative dental experiences (NDEs) are visits to the dentist reported as unpleasant, aversive or traumatic [12, 13]. Although they can happen at any stage of life, they are more common during childhood and adolescence [14, 15]. NDEs in early life may condition the development of dental anxiety [16-19], which may in turn lead o dental avoidance and poorer oral health in later life [18, 20]. Although NDEs were associated with poorer adult oral health in a cross-sectional study [21], the only longitudinal study to date found no association between a negative experience during the first dental visit and dental attitudes and beliefs in adulthood [22]. Therefore, the long-term impact of childhood NDEs on dental visits and oral health in adult life is still unknown.

The primary aim of this study was to explore the association between childhood NDEs and changes in tooth loss among Swedish older adults. A secondary aim was to explore the role of dental visits in explaining such an association. We hypothesised that early life NDEs are positively associated with tooth loss in later life and that dental visits explain, at least partially, this association.

METHODS

This study used 25-year data from on ongoing cohort of Swedish adults born in 1942. The study protocol was approved by a Research Ethics Committee in Sweden. The present study adheres to the Strengthening the Reporting of Observational Studies (STROBE) statement.

Data source

Data collection started when participants were 50 years (1992) and have been repeated quinquennially since then. In 1992, all individuals born in 1942 (in Sweden and abroad) living in Örebro and Östergötland (Central and South-eastern Sweden, respectively) were invited to participate in the study.

Details of the recruitment procedures have been published elsewhere [23]. Of the total population of 8888 adults, 6346 (71.4%) agreed to participate. The cross-sectional participation rate was 74.3% (6513/8764) in 1997 (55 years), 75.0% (6372/8500) 2002 (60 years), 73.1% (6078/8313) in 2007 (65 years), 72.2% (5697/7889) in 2012 (70 years) and 70.6% (5092/7204) in 2017 (75 years). Percentages of baseline respondents have been computed for the following waves; 5364 (84.5% of baseline) participated in 1992 and 1997, 4736 (74.6% of baseline) participated in 1992, 1997 and 2002, 4143 (65.0% of baseline) participated 1992, 1997, 2002 and 2007, 3585 (56.5% of the baseline responders) participated in 1992, 1997, 2002, 2007, and 2012. Of the 6346 participants who completed the 1992 survey, 3060 (48.2% of baseline) participated in all 6 surveys, leaving 3286 as drop-outs at some of the postal follow-ups. Data were collected through postal questionnaires with most questions repeated at every wave.

A total of 6281 adults had data on childhood NDEs in 1992 and tooth loss in at least one wave. Of these, 6154 (98.0%) had data on all included variables at any time point. Overall, 1901 (30.9%) had complete data for all six waves, 1340 had data for five waves (21.8%), 1070 (17.4%) for four waves, 703 (11.4%) for three waves, 601 (9.8%), and 539 (8.8%) for one wave.

Measures

The outcome measure for this study was tooth loss. At every wave, participants reported how many of their natural permanent teeth they had using 5-response options (all teeth, missing a few, missing many, missing nearly all, all teeth lost). Responses were recoded as ‘all teeth maintained//missing a few’ (reference group) and ‘missing many/nearly all/all teeth’. This measure has been used in analysis of earlier waves of the cohort [5, 24]. The prevalence of tooth loss was estimated for every wave and treated as a repeated outcome measure during analysis.

The exposure of interest was childhood NDEs, treated as time-invariant because it was collected retrospectively at baseline (in 1992). Participants were asked whether they have had any unpleasant or frightening experience during dental treatment as a child (before 20 years of age). Four response options were given: no (reference group); yes, sometimes; yes, several times; and don’t remember. Those who replied that they did not remember (n=268) were combined with the reference group under the assumption that if they were not remembered they could not affect oral health in later life.

Several variables were included in the analysis as potential confounders of the association between childhood NDEs and tooth loss in later life. Early life socioeconomic conditions were measured using education (primary, secondary and higher) and country of birth (native- versus foreign-born). Adult socioeconomic position was measured by working status (full-time, part-time, no occupation). Since most participants retired as the cohort aged, we used data on working status at baseline only. All socioeconomic variables and gender were treated as time-invariant. Time-variant covariates included were marital status (cohabiting vs. not cohabiting) and health behaviours (smoking, snuff use and toothbrushing). Smoking status and snuff use were reported using four options (daily, sometimes, quitted and never). Responses were dichotomised as non-smoker vs. smoker (past or current), and non-snuffer vs. snuffer (past or current), respectively. Toothbrushing frequency was reported on a 5-response scale (never/seldom, once a week, once daily, twice a day, more than twice a day) and responses dichotomised as twice daily or more often vs. once daily or less often. Dental visiting was the potential mediator of the association between childhood NDEs and tooth loss. Participants reported their last dental visit using 4 options (less than 1 year, 1-2 years, 3-5 years and more than 5 years ago). Responses were dichotomised as within the past year vs. more than a year ago.

Statistical analysis

Baseline characteristics were first compared between participants reporting none, some and several NDEs. We then compared tooth loss at every wave between groups defined according to NDEs and all covariates assessed. Chi-squared tests were applied for these crude comparisons.

Mixed effects logistic regression models were fitted to model the 25-year change in tooth loss. The mixed effects models use all available outcome data over the follow-up period, handle unevenly spaced observations over time and account for the fact that repeated measures on the same individual are correlated [25]. We used wave information (1992=0, 1997=1, 2002=2, 2007=3, 2012=4 and 2017=5) as a continuous time indicator, with the intercept fitted as a random effect (random intercept model, RIM) to model individual variations in tooth loss. An unstructured covariance matrix of the residuals was applied in the estimation.

First, a RIM model with wave and childhood NDEs was fitted to determine the rate of change in tooth loss, within the categories of NDEs, during the 25-year follow-up. We then tested the association of NDEs with the 25-year change in tooth loss in three sequential models. The association of NDEs with

tooth loss adjusted for all confounders (sex, country of birth, education, working status, marital status, snuffing habits, smoking status and toothbrushing frequency) was reported in Model 1. In this model, the estimates for each predictor represent its average effect on tooth loss over the timespan. The interaction (product-terms) of each predictor with the time indicator (wave) were added in Model 2, one at a time, to test their statistical significance. Wald tests were used to check whether the addition of main effects or interaction term improved the goodness-of-fit of the model. The null hypothesis for the Wald-test assumes that the term is equal to zero. For the interaction terms, a non-significant Wald-test resulted in a model containing only the main effects of the predictors. Only significant interactions were maintained in the model. Finally, the role of dental visits in explaining the association between NDEs and tooth loss was tested by comparing the estimate for tooth loss from Model 2 with that from a model also containing last dental visit (Model 3). We also tested the interaction of last dental visit with time as described above. Stata 15 (StataCorp LP, College Station, TX) was used for the statistical analyses. The mixed effects models were fitted using Markov Chain Monte Carlo (MCMC) estimation in MLwiN 3.02 (Centre for Multilevel Modelling, University of Bristol, UK). The models were run from Stata using the Stata-package *runmlwin*.

RESULTS

We analysed data of 6154 adults (50% women), aged 50 years in 1992. The prevalence of tooth loss was 21.4% (95%CI: 20.3-22.4), 22.3% (95%CI: 21.1-23.5), 24.1% (95%CI: 22.8-25.4), 25.4% (95%CI: 24.1-26.7), 25.1% (95%CI: 23.7-26.5), and 23.7% (95% CI: 22.3-25.2) in 1992, 1997, 2002, 2007, 2012 and 2017, respectively. In addition, 38.0% (95%CI: 36.8-39.2), 33.4% (95%CI: 32.2-34.6) and 28.6% (95%CI: 27.5-29.8) of participants reported none, some and several NDEs, respectively in 1992. Participants with several childhood NDEs were more likely to be female, Swedish-born and smoker and less likely to have visited the dentist in the past year than those with no early NDEs (Table 1).

Table 2 shows the crude associations of childhood NDEs and covariates with tooth loss at every wave. For time variant covariates, cross-sectional associations with tooth loss in each wave were presented. In every wave, significant direct linear trends in prevalence of tooth loss were found according to childhood NDEs and working status whereas significant inverse linear trends in prevalence of tooth loss were found according to education. Higher prevalence of tooth loss was found among foreign-born participants and those not cohabiting as well as among smokers, those brushing once or less often than daily and those who visited the dentist more than a year ago.

The RIM model with time and childhood NDEs as the only predictors showed an increase of 1.27 (95% CI: 1.23-1.31) units in the odds of tooth loss per additional 5 years of follow-up. In the same model, childhood NDEs was positively associated with tooth loss, with participants reporting NDEs sometimes and several times having 1.83 (95%CI: 1.42-2.39) and 7.50 (95%CI: 5.24-10.12) greater odds of experiencing tooth loss than those reporting no NDEs (these estimates are only shown in the text). This association remained significant after adjustment for confounders (Model 1, Table 3). The interaction between childhood NDEs and time was significant when added to the main effect models, suggesting that the three NDEs groups had different trajectories of tooth loss over time. Significant interactions with time were also found for education, country of birth, working status, smoking status, toothbrushing frequency and gender (Model 2, Table 3). Predicted probabilities of tooth loss were calculated from Model 2 to show differences between NDEs groups over time. In 1992, the predicted probability of tooth loss was 17.1% (95%CI: 15.4-18.7), 21.4% (95%CI: 19.5-23.3) and 30.6% (95%CI: 28.3-33.0) for participants reporting none, some and several NDEs during childhood. Twenty-five years later, their corresponding predicted probabilities were 20.1% (95%CI: 17.9-22.2), 24.8% (95%CI: 22.3-27.2) and 31.4% (95%CI: 28.6-34.2), respectively (Figure 1).

The association between childhood NDEs and tooth loss remained unchanged after subsequent adjustment for the time-variant indicator of dental visits (Model 3, Table 3). Participants that visited the dentist more than a year ago had 1.40 (95%CI: 1.17-1.66) greater odds of experiencing tooth loss than those who visited the dentist less than a year ago. The interaction of last dental visit with time was not significant when tested (p=0.537) and thus, was dropped from the final model.

DISCUSSION

This longitudinal study in Swedish adults found that the recall of childhood NDEs was associated with changes in tooth loss after age 50 years. Although dental visiting in the last year was associated with both childhood NDEs and tooth loss, it explained very little of the association between childhood NDEs and tooth loss in later life. The present findings were robust to adjustments for multiple confounders, including early life and current socioeconomic position as well as behaviours.

Strengths of this study were the life course conceptualization emphasizing early life as a susceptible period for the development of oral health and the use of panel data. That said, the study also had some limitations. First, the outcome measure, tooth loss, was measured through self-reports, which can

incorporate measurement error. However, a high level of agreement has been reported between self-reported and clinically assessed number of teeth in diverse settings [26-29]. In addition, our prevalence of total tooth loss amounting to 2.3% among 75-year olds was very close to estimates from the latest Swedish national oral health survey where 2.1% of 70-79-year-olds were edentulous [30]. Second, information on childhood NDEs was collected retrospectively when participants were aged 50 years. Retrospective assessments may induce differential misclassification of exposure. Memory may reconstruct events as traumatic in order to validate an individual's fear [31]. Whilst the events may have occurred, the labelling of the event as negative is a subjective judgement, which is itself open to bias [31, 32]. That said, recent evidence suggests that recall bias is stronger for subjective assessments, such as family subjective social status during childhood, than for concrete events, such as parental education or experience of childhood abuse [33]. In addition, although recall bias could have affected estimates at baseline (when NDEs and tooth loss were measured concurrently), it is less likely to have affected reports of tooth loss later in life (trajectories). Third, the study did not account for the possible effects of prior positive dental experiences on dental anxiety and adult oral health [34, 35].

The first finding of this study was the clear dose-response relationship between childhood NDEs and tooth loss in later life. The magnitude of this effect was such that participants exposed to some and several NDEs were, respectively, 2 and 7 times more likely to experience tooth loss in older life than those with no childhood NDEs. In addition, these differences remained stable over time. Taken together, the above findings add support to the critical period life course epidemiology model which suggests that adverse early life circumstances have enduring effects on risk of disease in later life stages [2]. It is important to mention here that the 1942 cohort investigated in this study benefited from highly subsidised fees for all kinds of treatment by the Swedish public dental health care services built up during the 1940s and 1950s. However, their early years during the Second World War and immediately after were characterised by a high caries prevalence, food rich in sugars and lack of dentists. This situation might explain the relatively high prevalence of NDEs reported in this study as a cohort effect. Such experiences were not uncommon in those age groups.

Our hypothesised mechanism to explain this association was the avoidance and delay of dental visits caused by previous NDEs, the so-called 'vicious circle of dental fear and avoidance' that features prominently in Mowrer's two-factor theory of avoidance learning [36]. However, the second finding of this study was the small role that dental visits played in explaining the association between childhood

NDEs and tooth loss in late adulthood. There was little variation in the regression estimates for childhood NDEs after accounting for last dental visit. Two possible explanations for this finding come to mind. A first explanation is that we used a proxy for dental avoidance, which was based on the time since the last dental visit only. Shorter intervals between dental visits might reflect the need for acute dental care and problem-oriented attendance. However, as many individuals base their dental visiting on perceived needs, it is also possible that our indicator did not fully capture the intended behaviour. Data on avoidance or delaying dental visits would have been preferred but was not collected as part of the study. A second explanation is that dental visits do not have a role to play in the effect of childhood NDEs on adult oral health, which implies that other factors are more relevant. Dental anxiety is one of those factors, with evidence pointing to the role of NDEs in the development of early-onset dental anxiety [16-19]. Dental attitudes and beliefs are other potential factors. Although a previous longitudinal study found a general lack of association between a negative experience during the first dental visit and dental attitudes and beliefs in adulthood, the authors did find it associated with the belief that dental visits are not important to prevent dental problems [22]. But even with these alternative factors, it is difficult to see how they could affect adult oral health if not through the avoidance and postponement of dental visits.

This study has implications for practice and further research. The development of a positive patient-dentist relationship starts early in life. Early visits to the dentist facilitate socialisation and promote comfort with and expectations of subsequent visits [22]. We must incentivise early visits to the dentist, preferably during the first year of life, so a strong patient-dentist relationship can be built during childhood. Comprehensive, regular and patient-centre care is essential to build an enduring relationship of trust between people and healthcare providers [37]. As for further research, future longitudinal studies would benefit from collecting information on NDEs prospectively. The use of multiple informants (parents or guardians for example) or multiple items could be ways to reduce measurement error in reports of childhood NDEs. Asking about dental avoidance and delay and the reason behind those behaviours would also help elucidate potential mechanisms.

CONCLUSION

This longitudinal study among Swedish older adults showed that childhood negative dental experiences were independently associated with greater odds of experiencing tooth loss over time. Information on

the last dental visit, treated as a time-varying variable in the analysis, explained very little of the association between childhood negative dental experiences and tooth loss in later life.

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The authors declare no conflicts of interest in relation to this work.

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Table 1. Comparison of baseline characteristics between participants reporting none, some and several negative dental experiences (NDEs) during childhood

Baseline characteristics	Total	Childhood negative dental experiences						P value[a]
		None		Sometimes		Several times		
Gender								
Female	2944	1034	46.2%	987	49.8%	923	55.0%	<0.001
Male	2950	1202	53.8%	993	50.2%	755	45.0%	
Country of birth								
Native-born	5534	2045	91.5%	1898	95.9%	1591	94.8%	<0.001
Foreign-born	360	191	8.5%	82	4.1%	87	5.2%	
Education								
Low	2306	896	40.1%	723	36.5%	687	40.9%	0.025
Medium	1867	679	30.4%	674	34.0%	514	30.6%	
High	1721	661	29.6%	583	29.4%	477	28.4%	
Working status								
Full-time	4400	1685	75.4%	1494	75.5%	1221	72.8%	0.120
Part-time	1109	404	18.1%	374	18.9%	331	19.7%	
No occupation	385	147	6.6%	112	5.7%	126	7.5%	
Marital status								
Cohabiting	4868	1828	81.8%	1666	84.1%	1374	81.9%	0.083
Not cohabiting	1026	408	18.2%	314	15.9%	304	18.1%	
Snuff use								
Non-snuffer	5516	2101	94.0%	1850	93.4%	1565	93.3%	0.641
Snuffer	378	135	6.0%	130	6.6%	113	6.7%	
Smoking status								
non-Smoker	3973	1571	70.3%	1350	68.2%	1052	62.7%	<0.001
Smoker	1921	665	29.7%	630	31.8%	626	37.3%	
Toothbrushing frequency								
Twice daily or more often	4921	1855	83.0%	1667	84.2%	1399	83.4%	0.555
Once daily or less often	973	381	17.0%	313	15.8%	279	16.6%	
Last dental visit								
Within the past year	5175	1963	87.8%	1770	89.4%	1442	85.9%	0.006
More than 1 year ago	719	273	12.2%	210	10.6%	236	14.1%	

[a] Chi-squared test was used for comparisons

Table 2. Prevalence of tooth loss by childhood negative dental experiences (NDEs) and covariates at every wave.

Time-invariant	**1992 (n=5894)**	**1997 (n=4732)**	**2002 (n=4329)**	**2007 (n=4242)**	**2012 (n=3656)**	**2017 (n=3383)**
Childhood NDEs						
No	369 (16.5%)	307 (17.1%)	331 (20.2%)	310 (19.6%)	267 (19.0%)	258 (19.9%)
Yes, sometimes	395 (19.9%)	327 (20.3%)	324 (21.8%)	368 (25.1%)	319 (25.5%)	268 (23.1%)
Yes, several times	496 (29.6%)	419 (31.7%)	388 (32.3%)	400 (33.5%)	331 (33.1%)	277 (29.8%)
P value for trend[a]	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Gender						
Female	633 (21.5%)	506 (21.5%)	539 (24.7%)	550 (25.5%)	470 (25.2%)	393 (22.4%)
Male	627 (21.3%)	547 (23.0%)	504 (23.4%)	528 (25.3%)	447 (24.9%)	410 (25.1%)
P value[a]	*=0.817*	*0.207*	*0.319*	*0.896*	*0.821*	*0.067*
Country of birth						
Native-born	1113 (20.1%)	952 (21.3%)	972 (23.6%)	988 (24.5%)	850 (24.4%)	753 (23.4%)
Foreing-born	147 (40.8%)	101 (38.3%)	71 (33.8%)	90 (41.7%)	67 (39.4%)	50 (31.3%)
P value[a]	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*0.023*
Education						
Low	709 (30.7%)	585 (31.9%)	546 (33.1%)	554 (33.4%)	421 (31.7%)	342 (28.3%)
Medium	344 (18.4%)	291 (19.2%)	290 (21.0%)	314 (23.5%)	292 (24.6%)	250 (22.7%)
High	207 (12.0%)	177 (12.8%)	207 (15.9%)	210 (16.9%)	204 (17.9%)	211 (19.6%)
P value for trend[a]	*=0.004*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Working status						
Full time	885 (20.1%)	749 (21.0%)	753 (23.2%)	788 (24.8%)	684 (24.7%)	623 (24.1%)
Part time	228 (20.6%)	201 (22.2%)	202 (23.5%)	201 (24.1%)	173 (23.4%)	128 (19.5%)
No occupation	147 (38.2%)	103 (38.9%)	88 (39.8%)	89 (39.2%)	60 (40.8%)	52 (36.4%)
P value for trend[a]	*<0.001*	*<0.001*	*<0.001*	*0.001*	*0.014*	*0.537*
Time-variant[b]	**1992**	**1997**	**2002**	**2007**	**2012**	**2017**
Marital status						
Cohabiting	979 (20.1%)	837 (21.2%)	860 (23.0%)	774 (23.1%)	661 (23.6%)	528 (21.7%)
Not cohabiting	281 (27.4%)	216 (27.8%)	183 (30.7%)	304 (34.0%)	256 (30.0%)	275 (28.8%)
P value[a]	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Snuff use						
Non-snuffer	1181 (21.4%)	907 (22.0%)	950 (23.7%)	986 (24.9%)	858 (24.8%)	761 (23.5%)
Snuffer	79 (20.9%)	146 (24.2%)	93 (28.4%)	92 (32.3%)	59 (29.5%)	42 (30.4%)
P value[a]	*0.815*	*0.216*	*0.056*	*0.006*	*0.139*	*0.060*
Smoking status						
non-Smoker	662 (16.7%)	675 (18.3%)	717 (20.7%)	792 (22.1%)	758 (23.1%)	695 (22.1%)
Smoker	598 (31.1%)	378 (36.0%)	326 (37.7%)	286 (43.5%)	159 (42.4%)	108 (45.4%)
P value[a]	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Toothbrushing frequency						
At least twice a day	986 (20.0%)	821 (20.8%)	839 (23.2%)	868 (24.3%)	722 (23.3%)	626 (21.9%)
Less than twice a day	274 (28.2%)	232 (29.4%)	204 (28.8%)	210 (31.3%)	195 (35.0%)	177 (34.0%)
P value[a]	*<0.001*	*<0.001*	*0.001*	*<0.001*	*<0.001*	*<0.001*
Last dental visit						
Less than 1 year ago	1003 (19.4%)	875 (20.6%)	833 (22.4%)	852 (23.2%)	737 (23.3%)	627 (21.7%)
More than 1 year ago	257 (35.7%)	178 (36.1%)	210 (34.8%)	226 (39.3%)	180 (37.0%)	176 (35.3%)
P value[a]	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*

[a] Chi-squared was used when comparing two groups. Chi-squared for linear trends in crude logistic regression models was used when comparing 3 or more groups.
[b] Cross-sectional associations at every wave were reported with time-variant covariates.

Table 3. Mixed effects logistic model for the association between childhood negative dental experiences (NDEs) and tooth loss over 25 years (n=6154)

	Model 1[a]		Model 2[a]		Model 3[a]	
	OR[b]	**[95% CI]**	**OR[b]**	**[95% CI]**	**OR[b]**	**[95% CI]**
Time, per 5 years	1.31	[1.27-1.35]***	1.16	[1.08-1.25]***	1.17	[1.08-1.26]***
Childhood NDEs (reference: No)						
Yes, sometimes	2.06	[1.55-2.90]***	2.35	[1.65-3.16]***	2.34	[1.68-3.46]***
Yes, several times	7.08	[5.48-9.58]***	8.74	[6.09-12.20]***	8.79	[6.39-12.61]***
Gender (reference: Female)						
Male	1.06	[0.82-1.44]	0.94	[0.67-1.26]	0.99	[0.74-1.28]
Country of birth (reference: Sweden)						
Non-Sweden	9.68	[5.82-15.41]***	14.49	[8.45-24.52]***	13.99	[7.75-26.00]***
Education (reference: low)						
Medium	0.24	[0.18-0.31]***	0.18	[0.11-0.26]***	0.18	[0.12-0.25]***
High	0.09	[0.06-0.12]***	0.05	[0.03-0.08]***	0.06	[0.04-0.08]***
Working status (reference: Full-time)						
Part-time	0.78	[0.54-1.07]	0.88	[0.57-1.33]	0.98	[0.66-1.37]
No occupation	5.78	[3.35-9.17]***	4.80	[2.96-8.00]***	5.33	[3.06-8.84]***
Marital status (reference: cohabiting)						
Not cohabiting	1.22	[1.00-1.51]*	1.29	[1.08-1.60]**	1.26	[1.03-1.55]*
Snuff use (reference: Non-snuffer)						
Snuffer	1.15	[0.88-1.50]	1.14	[0.88-1.50]	1.13	[0.86-1.48]
Smoking status (reference: Non-smoker)						
Smoker	1.94	[1.60-2.32]***	1.38	[1.11-1.71]***	1.40	[1.12-1.75]***
Toothbrushing frequency (reference: At least twice a day)						
Less than twice a day	1.20	[1.00-1.44]*	0.94	[0.71-1.22]	0.95	[0.72-1.27]
Time by Childhood NDEs						
Time by Yes, sometimes			0.95	[0.89-1.03]	0.99	[0.74-1.28]
Time by Yes, several times			0.91	[0.85-0.98]**	0.91	[0.84-0.97]**
Time by Education						
Time by Medium			1.16	[1.08-1.23]***	1.16	[1.08-1.25]***
Time by High			1.25	[1.16-1.34]***	1.25	[1.17-1.34]***
Time by Working status						
Time by Part-time			0.93	[0.86-1.00]*	0.92	[0.85-1.00]*
Time by No occupation			1.09	[0.97-1.23]	1.07	[0.93-1.24]
Time by Country of birth						
Time by non-Sweden			0.82	[0.72-0.94]**	0.83	[0.72-0.93]**
Time by Gender						
Time by Male			1.05	[0.98-1.13]	1.05	[0.98-1.13]
Time by Smoking status						
Time by Smoker			1.23	[1.14-1.33]***	1.23	[1.12-1.33]***
Time by Toothbrushing frequency						
Time by Less than twice/day			1.11	[1.01-1.21]*	1.10	[1.01-1.20]*
Last dental visit (reference: Less than 1 year ago)						
More than 1 year ago					1.40	[1.17-1.66]***
Intra-class correlation	0.83		0.83		0.83	

[a] Mixed effect logistic regression was fitted and odds ratios (OR) reported.
[b] Model 1 reports main effects of all predictors. Model 2 reports main effects and significant interactions of predictors with time. Model 3 also adjusts for last dental visit.
* p<0.05; ** p<0.01; *** p<0.001

Figure 1. Predicted probabilities of tooth loss according to childhood NDEs, gender, country of birth, education, working status, smoking status and toothbrushing frequency. Predicted probabilities derived from a mixed effect logistic model including time, gender, country of birth, education, working status, marital status, snuff use, smoking status, tooth brushing frequency and childhood NDEs plus the two-way interactions of childhood NDEs, gender, country of birth, education, working status, smoking status and toothbrushing frequency with time (Model 2 in Table 3).